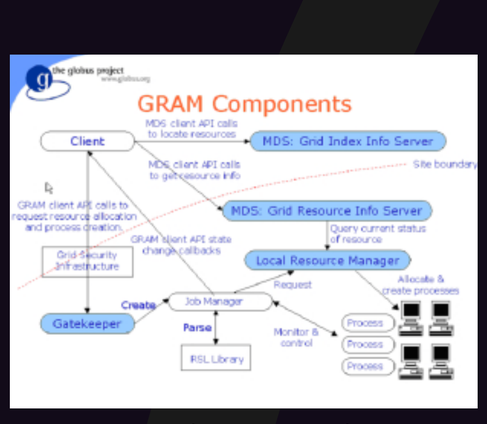
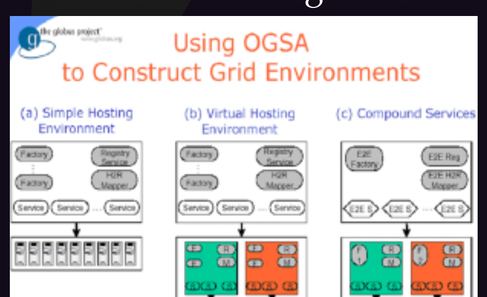
The Development of a Grid-based Engineering Design Problem Solving Environment – *continued*

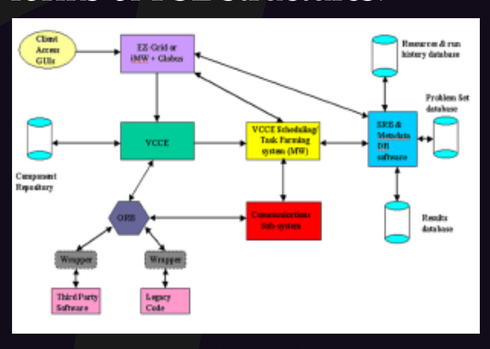
This article may be found at
http://www.soton.ac.uk/~cedc/posters.html



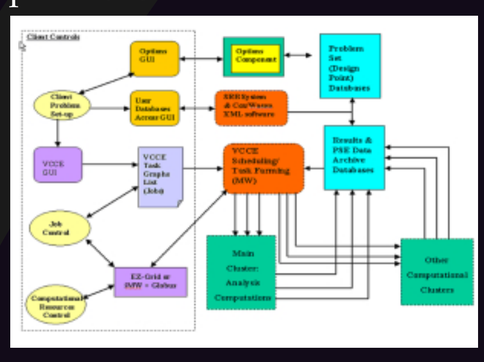
computers for scientific problem solving. Closely aligned with the concept of grid computing is the idea of portal computing. A user or application portal is a web-based collection of information presented together on a browser page. In portal computing well-defined services are delivered to the portals instead of giving users direct access to the operating system prompt. As a result, resource management and security can be exercised at a higher level.



The Open Grid Services Architecture (OGSA) is a proposed evolution of the current Globus Toolkit towards a Grid system architecture based on an integration of Grid and Web Services concepts and technologies. The Globus Toolkit is a community-based, open-architecture, open-source set of services and software libraries that support Grids and Grid applications. The toolkit addresses issues of security, information discovery, resource management, data management, communication, fault detection, and portability. Web services define a technique for describing software components to be accessed, methods for accessing these components, and discovery methods that enable the identification of relevant service providers. OGSA defines standard interfaces and conventions, for the creation, termination, management, and invocation of stateful, transient services as named, managed entities with dynamic, managed lifetimes. Grid services can be configured to create various forms of PSE structures.



The proposed Grid based PSE design involves integrating a number of existing PSE and Globus based software packages in a layered structure, in order to provide a fully functional Engineering Design Grid Portal. The Globus project aims to provide PSE developers with Grid services for resource management, security and resource discovery. We propose using the PSE prototype described above to provide the basis for a Design Optimisation Grid portal. This involves extending the PSE functionality with the EZ-Grid/Globus (or iMW/Condor) software at a level above the existing VCCE system to provide for Grid user login, job submission, etc. In addition, the development of a task farming approach on the analysis side should de-couple optimisation from analysis task execution in order to exploit Grid technologies to gain more parallelism.



The aim of our Grid Portal/PSE system is to provide the computational workflow scheme shown in the figure above where analysis and search/optimisation tasks are de-coupled by the two central database systems (the Problem Set and Results databases). Thus the search and analysis tasks can compute asynchronously, with the Search Engine adding new design point data sets into the Problem Set database and large scale "task farming" on the analysis side. Here, a number of independent analysis tasks can be run in parallel over one or more linked computational clusters under some form of computational resource control. The analysis results are added to the Results database, where the Search Engine can be guided via the user or advisor (machine learning based) systems in selecting the most promising new design to analyse.

Future work:

As developed, the current PSE will be able to compute single or multi-point design evaluations over network clusters. However, in order to fully exploit parallel computation over intranet or even internet clusters and to provide an environment which more naturally meets the data-centric view of users, two additional major enhancements to the PSE are planned.

The first concerns scheduling and task farming. The ultimate goal is to achieve within the PSE, an asynchronous computational workflow pattern where analysis tasks can seek to exploit whatever computational resources are available in various workstation clusters (i.e., task farming), running independently of search/optimisation tasks. Communication between the search and analysis tasks is through the Problem Set and Results databases. Whilst the Options package has some of this functionality available through script files, this needs to be provided in a generic way through the development of a scheduling/task farming PSE component.

The second enhancement concerns computational resource and job control and the setting up of an Engineering Design Grid Portal. EZ-Grid provides a basic set of components for creating a grid portal, including a GUI for Grid authentication and login, a Job Manager for job submission and monitoring and a Broker Kernel for resource control. However, these components are likely to require considerable enhancements to work with the scheduling and task farming components above.

In the longer term, our PSE will need to incorporate a more powerful component model. The original intention was to adopt the CORBA 3 Component Model, but now the Globus project OGSA work looks to offer similar functionality as part of the Globus Toolkit 3.0.

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